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NATIONAL DAM SAFETY PROGRAM. CONSERVATION CLUB LAKE DAM (MO 304--ETC(U)
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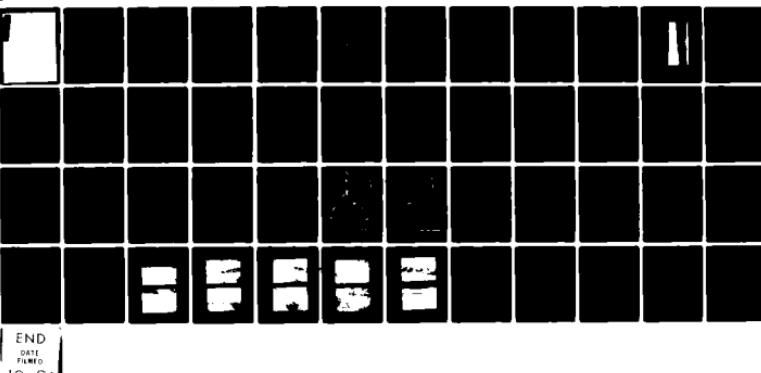
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

SUBJECT: Conservation Club Lake Dam (Mo. 30414)

This report presents the results of field inspection and evaluation of the Conservation Club Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY:

SIGNED

Chief, Engineering Division

20 DEC 1979

Date

APPROVED BY:

SIGNED

Colonel, CE, District Engineer

20 DEC 1979

Date

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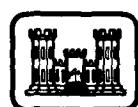
MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

CONSERVATION CLUB LAKE DAM

JEFFERSON COUNTY, MISSOURI

MO 30414

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



**United States Army
Corps of Engineers**
*...Serving the Army
...Serving the Nation*

St. Louis District

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

DECEMBER 1979

CONSERVATION CLUB LAKE DAM - MISSOURI INVENTORY NO. 30414

JEFFERSON COUNTY, MISSOURI

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

HORNER & SHIFRIN, INC.
5200 OAKLAND AVENUE
ST. LOUIS, MISSOURI 63110

FOR:

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS

DECEMBER 1979

HS-7925

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Conservation Club Lake Dam
State Located:	Missouri
County Located:	Jefferson
Stream:	Selma Branch
Date of Inspection:	26 July 1979

The Conservation Club Lake Dam, was visually inspected by engineering personnel of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of this inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses a hazard to human life or property.

The following summarizes the findings of the visual inspection and the results of certain hydrologic/hydraulic investigations performed under the direction of the inspection team. Based on the visual inspection, the present general condition of the dam is considered to be satisfactory; however, the following deficiencies were noticed during the inspection and are considered to have an adverse effect on the overall safety and future operation of the dam:

1. A dense cover of vegetation (brush, trees and tall grass) that may conceal animal burrows, exists on the downstream face of the dam. Tree roots and animal burrows can provide passageways for seepage that could develop into a piping condition that could lead to failure of the dam.

- Page 1 -

2. A heavy growth of brush and small trees exist along the concrete lined invert section of the discharge channel. This growth will restrict channel flow and reduce the discharge capacity of the spillway that could result in flooding of the channel and possible damage to the downstream face of the dam.
3. The downstream end of the concrete lined spillway channel invert is in a deteriorated condition, as is evidenced by extensive cracking and settlement of the concrete pavement, as well as severe erosion of the pavement subgrade. Continued erosion of the spillway channel could affect the stability of the channel banks.
4. Underseepage, as evidenced by wet, soft ground and ponded water, was observed in the vicinity of the downstream toe of slope junction with the right abutment. Uncontrolled seepage can develop into a piping condition that could lead to failure of the dam.

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According to the criteria set forth in the recommended guidelines, the magnitude of the spillway design flood for the Conservation Club Lake Dam, which is classified as small in size and of high hazard potential, is specified to be a minimum of one-half the Probable Maximum Flood (PMF). Considering the fact that there are several commercial establishments (a Nickerson Farms Restaurant and two automotive service stations) are located just downstream of the dam, and that U.S. Highway 61 and Interstate Highway 55 also lie within the potential flood damage zone, it is recommended that the spillway for this dam be designed for the PMF. The Probable Maximum Flood (PMF) is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Results of a hydrologic/hydraulic analysis indicated that the existing spillway is inadequate to pass lake outflow resulting from a storm of PMP magnitude. The spillway is adequate to pass lake outflow resulting from the 1 percent chance (100-year frequency) flood and lake outflow corresponding to about 50 percent of the PMP lake inflow. According to the St. Louis District, Corps of Engineers, the length of the downstream damage zone, should failure of the dam occur, is estimated to be three and one-half miles. Accordingly, within the possible damage zone is U.S. Highway 61, Interstate Highway 55, three commercial buildings and four agricultural buildings.

A review of available data did not disclose that seepage or stability analyses of this dam was performed. This is considered a deficiency and should be rectified.

It is recommended that the Owner take the necessary action in the near future to correct or control the deficiencies and safety defects reported herein.

Karl L. Freese
Karl L. Freese
P.E. Missouri E-16182

Albert B. Becker, Jr.
Albert B. Becker, Jr.
P.E. Missouri E-9168

OVERVIEW CONSERVATION CHIEF LAKES TAN

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CONSERVATION CLUB LAKE DAM - ID. NO. 30414

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CONSERVATION CLUB LAKE DAM - ID NO. 30414

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. National Dam Inspection Act, Public Law 92-367, dated 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, directed that a safety inspection of the Conservation Club Lake Dam be made.

b. Purpose of Inspection. The purpose of this visual inspection was to make an assessment of the general condition of the dam with respect to safety and, based upon available data and this inspection, determine if the dam poses a hazard to human life or property.

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in "Recommended Guidelines for Safety Inspection of Dams," Appendix D to "Report of the Chief of Engineers on the National Program of Dams," dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Conservation Club Lake Dam is an earthfill type embankment rising approximately 30 feet above the original streambed. The embankment has an upstream slope (above the waterline) of 1v on 3h, a crest width of about 16 feet, and a downstream slope of 1v on 2.4h that flattens to 1v on 4.2h at a point about 18 feet

below the top of the dam. The length of the dam including the spillway section is approximately 590 feet. A plan and profile of the dam are shown on Plate 3 and a cross-section of the dam is shown on Plate 4. At normal pool elevation, the reservoir impounded by the dam, occupies approximately 19 acres. A 6-inch diameter pipe, with a control valve located in a concrete pit near the outlet end of the pipe, passes through the dam and serves as a lake drawdown facility.

The lake level is governed by a trapezoidal spillway section cut into bedrock and located at the left (west) abutment. The spillway crest is located approximately 100 feet upstream of the centerline of the dam. A concrete low-water bridge crosses the discharge channel immediately below the centerline of the dam. Four 6-inch diameter steel pipes are embedded in the bridge slab to enable low volume spillway releases to pass the bridge structure. Beginning approximately 50 feet below the centerline of the dam the invert of the spillway channel is paved with concrete. The paved section continues down the hillside of the adjacent watershed and joins the tributary of that watershed about 150 feet below the dam. A profile of the spillway channel is shown on Plate 4.

b. Location. The dam and lake are located on Selma Branch, approximately 6 miles southeast of Festus, Missouri, immediately west of Interstate Highway 55 and just south of U.S. Highway 61, as shown on the Regional Vicinity Map, Plate 1. The dam is located in Section 33, Township 40 North, Range 6 East, in Jefferson County.

c. Size Classification. The size classification based on the height of the dam and storage capacity, is categorized as small. (Per Table 1, Recommended Guidelines for Safety Inspection of Dams).

d. Hazard Classification. Conservation Club Lake Dam, according to the St. Louis District, Corps of Engineers, has a high hazard potential, meaning that if the dam should fail, there may be loss of life, serious damage to homes; or extensive damage to agricultural, industrial and commercial facilities, important public utilities, main highways, or

railroads. The estimated flood damage zone, should failure of the dam occur, as determined by the St. Louis District, extends three and one-half miles downstream of the dam. Within the possible damage zone is U. S. Highway 61, Interstate Highway 55, three commercial buildings, and four agricultural buildings.

e. Ownership. The lake and dam are owned by The Conservation Club. The address of the Conservation Club is: U.S. Highway 61 South, Festus, Missouri - 63028. Mr. Clifford Bins is the current secretary-treasurer of the club.

f. Purpose of Dam. The dam impounds water for recreational use by club members and their guests.

g. Design and Construction History. According to a representative of the Owner, the design, staking, and inspection of the dam while it was under construction was performed by a member of the Conservation Club, Mr. Charles LaRose and several of his associates. Mr. LaRose, now deceased, was an engineer, formerly employed by the Pittsburg Plate Glass Company. The dam was constructed in 1951, by the Bloomsdale Excavating Company of Bloomsdale, Missouri.

h. Normal Operational Procedure. The lake level is unregulated.

1.3 PERTINENT DATA

a. Drainage Area. The area tributary to the lake is essentially undeveloped and in a native state covered with timber. There are several dwellings and other buildings adjacent to the state road at the west side of the drainage area. The watershed above the dam amounts to approximately 166 acres. The watershed area is outlined on Plate 2.

b. Discharge at Damsite.

- (1) Estimated known maximum flood at damsite ... 30 cfs*
- (2) Spillway capacity ... 647 cfs (W.S. = Elev. 537.1)

*Based on an estimate of depth of flow as observed by a representative of the Owner.

c. Elevation (ft. above MSL). The following elevations were determined by survey and are based on a bench mark elevation (502.28) obtained from the Missouri State Highway Department and located at the southeast corner of the headwall for the culvert passing beneath Highway 61, approximately 35 feet north of the edge of the pavement and about 600 feet west of the centerline of Interstate Highway 55.

- (1) Top of dam ... 537.1 (min.)
- (2) Normal pool (spillway crest) ... 533.1
- (3) Streambed at centerline of dam ... 507₊
- (4) Maximum tailwater ... Unknown

d. Reservoir.

- (1) Length at normal pool (elevation 533.1) ... 1,500 ft.
- (2) Length at maximum pool (elevation 537.1) ... 1,900 ft.

e. Storage.

- (1) Normal pool ... 135 ac. ft.
- (2) Top of dam (incremental) ... 85 ac. ft.

f. Reservoir Area.

- (1) Normal pool ... 19 acres
- (2) Top of dam ... 24 acres

g. Dam.

- (1) Type ... Earthfill, homogeneous*
- (2) Length ... 590 ft.
- (3) Height ... 30₊ ft. (above original streambed)
- (4) Top width ... 16 ft.
- (5) Side slopes
 - A. Upstream ... 1v on 3h
 - B. Downstream ... 1v on 2.4h (above Elev. 519.3)
1v on 4.2h (below Elev. 519.3)

*Per a representative of the Owner.

- (6) Cutoff ... Clay core*
- (7) Slope protection
 - a. Upstream ... Pre-cast concrete slab, stone at spillway
 - b. Downstream ... Grass

h. Spillway.

- (1) Type ... Uncontrolled, rock ledge, trapezoidal section
- (2) Crest elevation ... 533.1
- (3) Approach channel ... Lake
- (4) Exit channel ... Earth cut, trapezoidal section partially paved invert

i. Lake Drawdown Facility.

- (1) Size ... 6-Inch steel pipe
- (2) Control ... Valve (at outlet end)
- (3) Elevation (Ft. above MSL) ... 511.9 (outlet)

j. Regulating Outlets. With the exception of the lake drawdown pipe, there are no outlets at this dam where lake outflow can be regulated.

*Per a representative of the Owner.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Mr. Marvin LaRose, a member of the Conservation Club Board of Directors at the time of construction of the dam reported that the design, staking and inspection of the dam while it was under construction was performed by Mr. Charles LaRose and several of his associates. Mr. Charles LaRose, a distant cousin of Marvin and an engineer formerly with the Pittsburg Plate Glass Company, is deceased. Attempts to obtain any design data were unsuccessful.

2.2 CONSTRUCTION

According to a representative of the Owner, any records maintained during construction of the dam are no longer available. Mr. Marvin Drury, a representative of the Bloomsdale Excavating Company, builders of the dam, reported that a 15-foot wide core trench was excavated along the centerline of the dam. When the trench reached a depth of about 5 feet, a sand seam was encountered and the trench was extended to about 20 feet in depth in order to reach sound rock. The material used to backfill the trench and construct the embankment, a silty, sandy clay, was obtained from the area to be occupied by the lake. Compaction was obtained by the equipment used to haul the fill.

Mr. Marvin LaRose also reported that due to the presence of a rock ledge at the planned spillway location, the spillway crest was raised about one foot higher than originally intended.

2.3 OPERATION

The lake level is governed by an uncontrolled spillway cut to rock at the left abutment. A representative of the Owner reported that the dam

has never been overtopped and that the highest lake level observed occurred this past spring (1979) when the lake reached a level estimated to be about one foot higher than the spillway crest.

2.4 EVALUATION

a. Availability. Engineering data for assessing the design of the dam and spillway were unavailable.

b. Adequacy. No data available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Conservation Club Lake Dam was made by Horner & Shifrin engineering personnel, K.L. Freese, Civil Engineer and Hydrologist, and A.B. Becker, Jr., Civil and Soils Engineer, on 26 July 1979. An examination of the dam site was also made by an engineering geologist, Jerry D. Higgins, a consultant retained by Horner & Shifrin for the purpose of assessing the area geology. Also examined at the time of the inspection, was the area below the dam within the potential flood damage zone. Photographs of the dam taken at the time of the inspection are included on Pages A-1 through A-5 of Appendix A.

b. Area Geology. The dam site is located on the northeastern flank of the Ozark Uplift where the bedrock strata are composed primarily of eastward-dipping limestones and sandstones that slope into the Illinois Basin.

The bedrock underlying the Conservation Club Lake and dam site is the St. Peter Sandstone, upon which a shallow covering of sandy, clay residual soil has developed. The St. Peter is characterized as a white, fine-to-medium-grained pure quartz sandstone. It is generally massively bedded and, although it is loosely cemented, exposed rock surfaces usually have been case hardened by the weathering process. Several outcrops of St. Peter sandstone occur around the lake, particularly along the eastern side and on the adjacent hillsides.

The abutments are moderately sloping, composed of bedrock and a thin veneer of unconsolidated materials. Several wet-weather springs were reported to be located in the tributary stream valleys, but no sign of flowing water was observed at the time of the inspection.

No adverse geologic conditions were observed that would be considered conducive to severe reservoir leakage or dam instability.

c. Dam. The visible portions of the upstream and downstream faces of the dam (see Photos 1 & 2) appeared to be in sound condition, although the downstream face of the dam has a dense cover of brush, small trees and weeds. In addition, several trees, up to 6-inches in diameter, exist on the downstream embankment near the left abutment. No animal burrows were noticed, but due to the dense cover of vegetation on the downstream face, it could not be concluded that none exist. Both the crest and upstream face of the dam have a well maintained cover of grass. The upstream face of the dam is protected from erosion by wave action by sections of pre-cast concrete panels approximately 1 inch in thickness, placed on a bed of 1-inch crushed stone (see Photo 9). No cracking of the surface or misalignment of the crest of the dam was evident.

Seepage, indicated by standing water, was noticed at the base of the dam near the right abutment. Since flow was indistinguishable an estimate of the seepage quantity could not be made.

A fabricated steel foot bridge crosses the spillway channel (see Photo 3) immediately downstream from the crest. The bridge supports rest on concrete pads but are not attached thereto. The spillway channel between the lake and the low-water bridge (see Photo 4) with the exception of the foot bridge is clear and well maintained. Stone riprap serves to protect the right bank or dam side of the spillway channel in the vicinity of the dam. The concrete low water bridge (see Photo 5) appeared to be in sound condition, although some cracking and spalling of the surface was apparent. A section of the outlet channel, beginning about 50 feet north of the dam centerline and extending to the valley floor, is paved across the invert with concrete (see Photo 6). With the exception of the section at the downstream end of the channel, (see Photo 7) which is undercut by erosion, broken and displaced, the concrete paved invert is in fair condition with only minor cracking and spalling due to weathering. Small trees and dense brush (see Photo 6) were also noticed adjacent to most of the paved spillway channel section.

The 3.5-foot by 4.5-foot concrete valve box with steel plate cover at the drawdown pipe outlet (see Photo 8) appeared to be in sound condition. However, the steel cover to the valve box could not be removed to examine the valve.

d. Downstream Channel. A restaurant and parking lot has been constructed in the area adjacent to the downstream channel (see Photo 10) immediately below the dam and south of Highway 61. Drainage from the watershed above the restaurant could be seen disappearing into a low area at the edge of the parking lot at the rear of the restaurant, however, an intake headwall or inlet structure was not noticed. Highway 61 is located just north of the parking lot, about 600 feet below the dam. A 6-foot by 6-foot box culvert carries the stream flow beneath the highway. At the upstream end of the box culvert on the south side of the highway, a concrete inlet structure has been constructed to collect drainage from the parking lot and part of the area south of the highway. Two 15-inch pipes and a 30-inch pipe are connected to the inlet structure. It is presumed that the 30-inch pipe carries the entire flow from the upper watershed, including the lake, beneath the restaurant parking lot.

Beyond Highway 61, the channel is unimproved and extends for approximately three miles before joining the Mississippi River. At a distance of about 2,000 feet, a 7-foot high by 8-foot wide box culvert allows the stream to pass beneath Interstate Highway 55. Between Interstate 55 and the Mississippi River, the stream winds through Selma Farms, a property owned by the Missouri Pacific Railroad Company. Immediately before joining the Mississippi River the stream passes under railroad tracks belonging to the St. Louis-San Francisco Railway Company.

e. Reservoir. The area adjacent to the lake is for the most part in a natural state and wooded. There did not appear to be significant sedimentation within the reservoir.

3.2 EVALUATION

The deficiencies observed during this inspection and noted herein, are not considered significant to warrant immediate remedial action.

Since it appears that spillway outflow must pass through a 30-inch pipe in order to continue downstream of Highway 61, it is likely that flooding of the area immediately below the dam will occur due to lack of capacity of this pipe as a result of runoff from storms of less than 1/2 the probable maximum flood magnitude.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillway is uncontrolled. The water surface level is governed by precipitation runoff, evaporation, seepage, and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM AND SPILLWAY

The upstream slope and crest of the dam are well maintained as is the area about the lake. Vegetation on the downstream slope is unattended. Judging from the deteriorated condition of the downstream end of the spillway channel as well as the dense growth of brush adjacent to the lower, paved section of the spillway channel, it is evident that these areas have received little attention. Also it would appear that there is a lack of concern for seepage problems or drainage of the affected areas. It was reported that muskrats are removed from the dam area during the winter time.

4.3 MAINTENANCE OF OUTLET OPERATING FACILITIES

With the exception of the lake drawdown pipe, no outlet operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEMS IN EFFECT

The inspection did not reveal the existence of a dam warning system.

4.5 EVALUATION

Inadequate or lack of maintenance is considered detrimental to the safety of a dam. It is recommended that maintenance of the dam and spillway be undertaken on a regular basis and that records be kept of all maintenance work performed.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data are not available. Procedures and data for determining the probable maximum flood, the 100-year frequency flood, and the discharge rating curve for flow passing the spillway and dam crest are presented on pages B-1 and B-2 of the Appendix.

b. Experience Data. The drainage area and lake surface area were developed from the USGS Selma, Illinois-Missouri, Quadrangle Map. The proportions and dimensions of the spillway and dam were developed from surveys made during the inspection.

c. Visual Observations.

- (1) The spillway, a trapezodial section founded on rock, has a bottom width of approximately 32 feet at the crest.
- (2) The spillway is located adjacent to the embankment at the left (west) abutment.
- (3) An 80-foot long, nearly level, grass-covered channel conducts flow through the spillway section. A low-water bridge, consisting of a 12-inch concrete slab with four 6-inch cast-iron pipes cast in the concrete to allow minor spillway flow to pass the bridge and continue downstream, is directly in line with the axis of the dam. Beginning at a point about 32 feet downstream of the low-water bridge the channel invert is paved with concrete. This paved invert section conducts flow away from the dam by following a course that leads to the valley immediately west of the dam watershed. The paved invert section is in a deteriorated condition throughout the reach that carries flow across the hillside.

- (4) An emergency spillway is not provided.
- (5) A 6-inch cast-iron pipe with a control valve near the outlet end is provided to dewater the lake. The pipe is exposed at the toe of the embankment where a concrete structure encloses the control valve.
- (6) It appears that lake outflow must pass through a 30-inch diameter pipe in order to reach the downstream channel north of Highway 61, approximately 600 feet below the dam. The upstream end of this pipe could not be located at the time of the inspection.

d. Overtopping Potential. The spillway is inadequate to pass the probable maximum flood without overtopping the dam. The spillway is capable of passing the 1 percent chance (100-year frequency) flood without overtopping the dam. The results of a dam overtopping analysis are as follows:

<u>Ratio of PMF</u>	<u>Q-Peak Outflow(cfs)</u>	<u>Max. Lake W.S. Elev.</u>	<u>Max. Depth (Ft.)</u>	<u>Duration of Overtopping Of Dam</u>
			<u>of Flow Over Dam (Elev. 537.1)</u>	<u>(Hours)</u>
0.50	647	537.1	0.0	0.2
1.00	3,025	538.3	1.2	1.8
100-Yr.Flood	50	534.3	0.0	0.0

Elevation 537.1 was found to be the lowest point in the dam crest. The flow safely passing the spillway just prior to overtopping was determined to be about 647 cfs, which is equivalent to about 50 percent of the probable maximum flood inflow. This outflow is greater than the outflow for the 1-percent chance (100-year frequency) flood. During peak

flow of the probable maximum flood, the greatest depth of flow over the dam would be approximately 1.2 feet and the overflow will extend about 550 feet along the crest of the dam; nearly the entire crest.

e. Evaluation. It is known that the type of material (silty, sandy clay) used to construct the dam can under certain conditions, such as high velocity flow, be very erodible. The downstream end of the spillway channel is extensively eroded due, primarily, to spillway flows at high velocities. For the PMF condition where the depth of flow overtopping the dam (1.2 feet maximum) and the duration of flow over the dam (1.8 hours) are appreciable, failure of the dam due to overtopping is a possibility.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observations. Visual observations which adversely affect the structural stability of the dam are discussed in Section 3, paragraph 3.1c.
- b. Design and Construction Data. No design or construction data relating to the structural stability of the dam are known to exist. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Operating Records. With the exception of the valve on the lake drawdown pipe, no appurtenant structures or facilities requiring operation exist at this dam. According to the Owner, no records are kept of the lake level, spillway discharge, dam settlement, or seepage.
- d. Post Construction Changes. According to the Owner, no post construction changes have been made which would affect the structural stability of the dam.
- e. Seismic Stability. Since the dam is located within a Zone II seismic probability area, an earthquake of the magnitude predicted is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A hydraulic analysis indicates the spillway is capable of passing lake outflow of about 647 cfs without the level of the lake exceeding the low point in the top of the dam. A hydrologic analysis of the lake watershed area, as discussed in Section 5, paragraph 5.1d, indicates that for storm runoff of probable maximum flood magnitude, the lake outflow would be on the order of 3,025 cfs; for one-half the PMF the lake outflow would be approximately 647 cfs; and that for the 1 percent chance (100-year frequency) flood, the lake outflow would be about 50 cfs.

Several items were noticed during the inspection that could adversely affect the safety of the dam. These items include seepage, brush, and trees on the downstream face of the dam, and erosion of the steep, downstream section of the spillway outlet channel.

Stability and seepage analyses of the dam were not available for review and therefore no judgment could be made with respect to the structural stability of the dam.

b. Adequacy of Information. Due to lack of design and construction data, the assessments reported herein were based on external conditions as determined during the visual inspection. The assessment of the hydrology of the watershed and capacity of the spillway were based on a hydrologic/hydraulic study as indicated in Section 5. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. The items concerning the safety of the dam noted in Paragraph 7.1a and the remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item regarding the spillway capacity recommended in paragraph 7-2a should be pursued on a high priority basis.

d. Necessity for Phase II. Based on the results of the Phase I Inspection, a Phase II investigation is not recommended.

e. Seismic Stability. Since the dam is located within a Zone II seismic probability area, an earthquake of the magnitude predicted is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

7.2 REMEDIAL MEASURES

a. Recommendations. The following actions are recommended:

(1) Based upon criteria set forth in the recommended guidelines, alterations to the design of the dam should be made in order to pass lake outflow resulting from a storm of probable maximum flood magnitude.

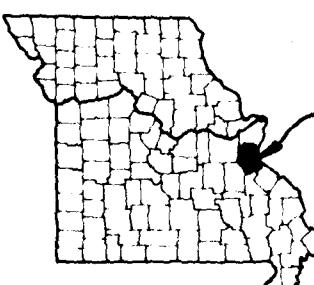
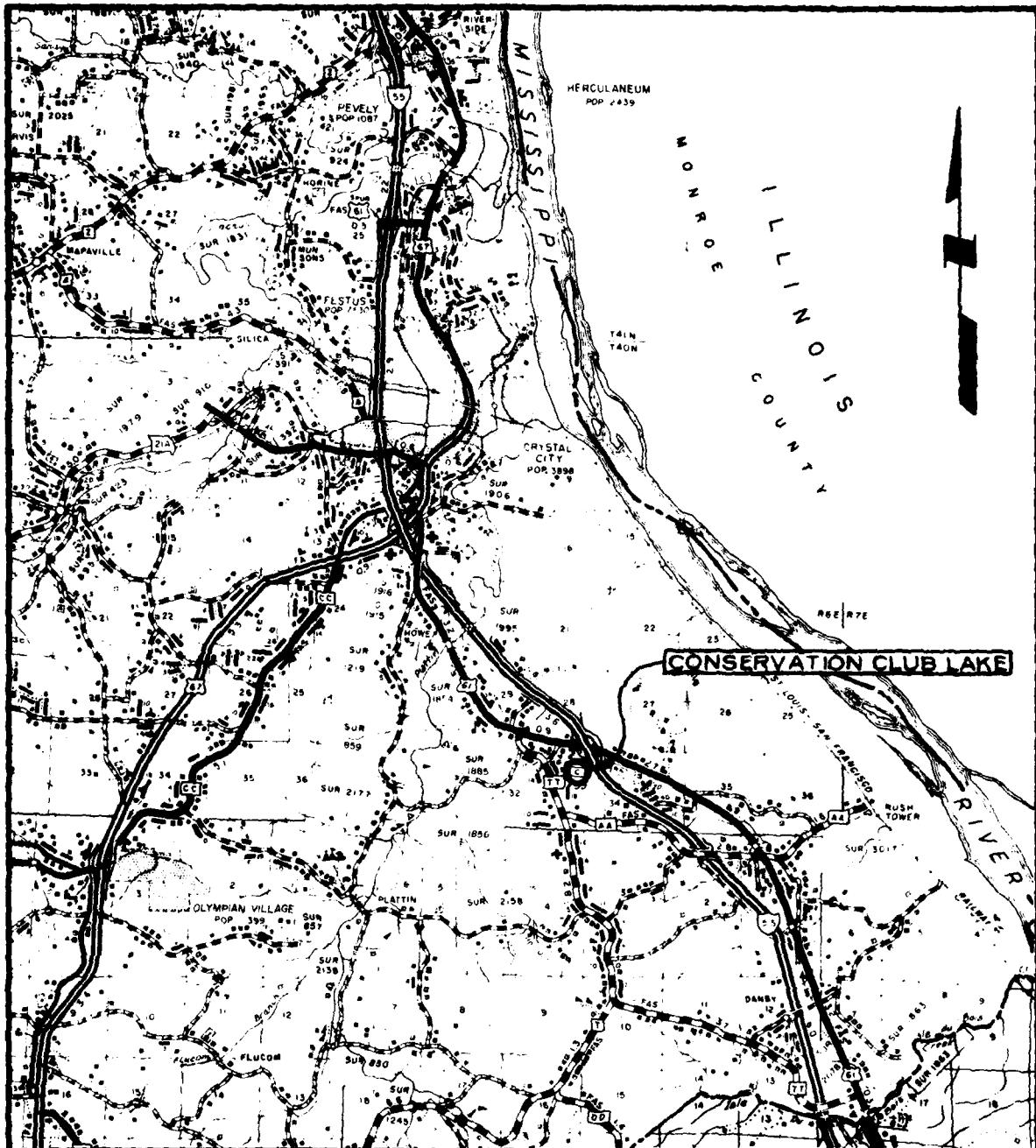
(2) Obtain the necessary soil data and perform dam stability and seepage analyses in order to determine the structural stability of the dam for all operational conditions. Seepage and stability analyses should be performed by a qualified professional engineer experienced in the design and construction of dams.

b. Operations and Maintenance (O & M) Procedures. The following O & M Procedures are recommended:

(1) Remove the trees and brush that may conceal animal burrows from the downstream face of the dam. Tree roots and animal burrows provide a passageway for seepage that can lead to a piping condition and subsequent failure of the dam. The existing turf cover should be restored if destroyed or missing. Maintain the

turf cover on the slopes at a height that will not hinder inspection of the slope or provide cover for burrowing animals. The removal of trees should be performed under the direction of an engineer experienced in the design and construction of earth dams.

- (2) Remove the brush and trees adjacent to the spillway outlet channel that restrict flow in the channel and reduce the discharge capacity of the section. Loss of spillway outlet capacity can result in flooding of the downstream face of the dam and conditions that could impair the stability of the embankment.
- (3) Restore the eroded areas of the spillway channel and provide some form of protection to prevent future erosion of the channel by spillway flow.
- (4) Provide some means of preventing piping (progressive internal erosion) due to seepage at the right abutment area. A piping condition could result in failure of the dam.
- (5) Provide maintenance of all areas of the dam including the lake drawdown control valve and spillway on a regularly scheduled basis in order to insure features of being in satisfactory operational condition.
- (6) A detailed inspection of the dam should be instituted on a regular basis by an engineer experienced in the design and construction of dams. It is also recommended, for future reference, that records be kept of all inspections made and remedial measures taken.



LOCATION MAP

REGIONAL VICINITY MAP

PLATE 1

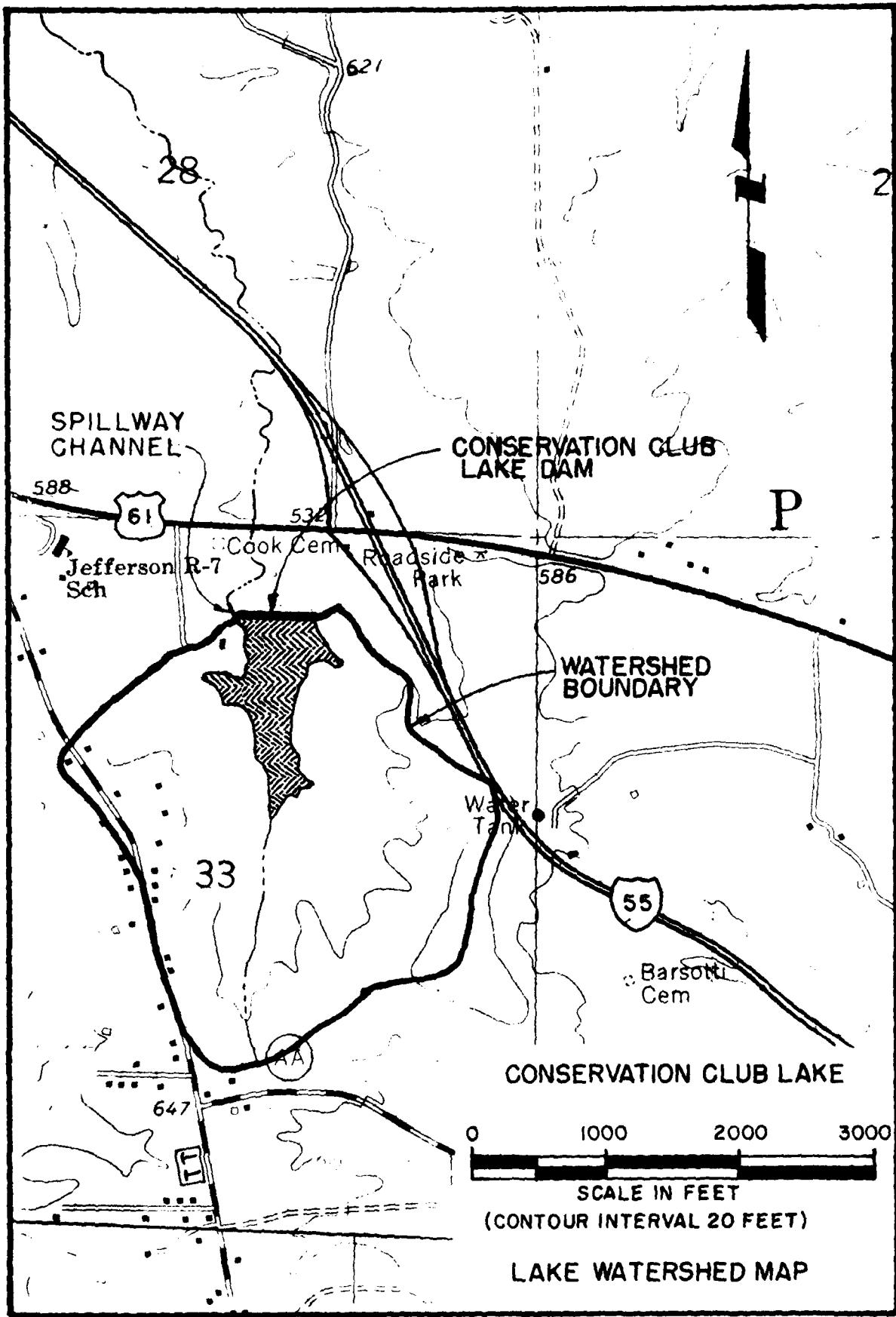
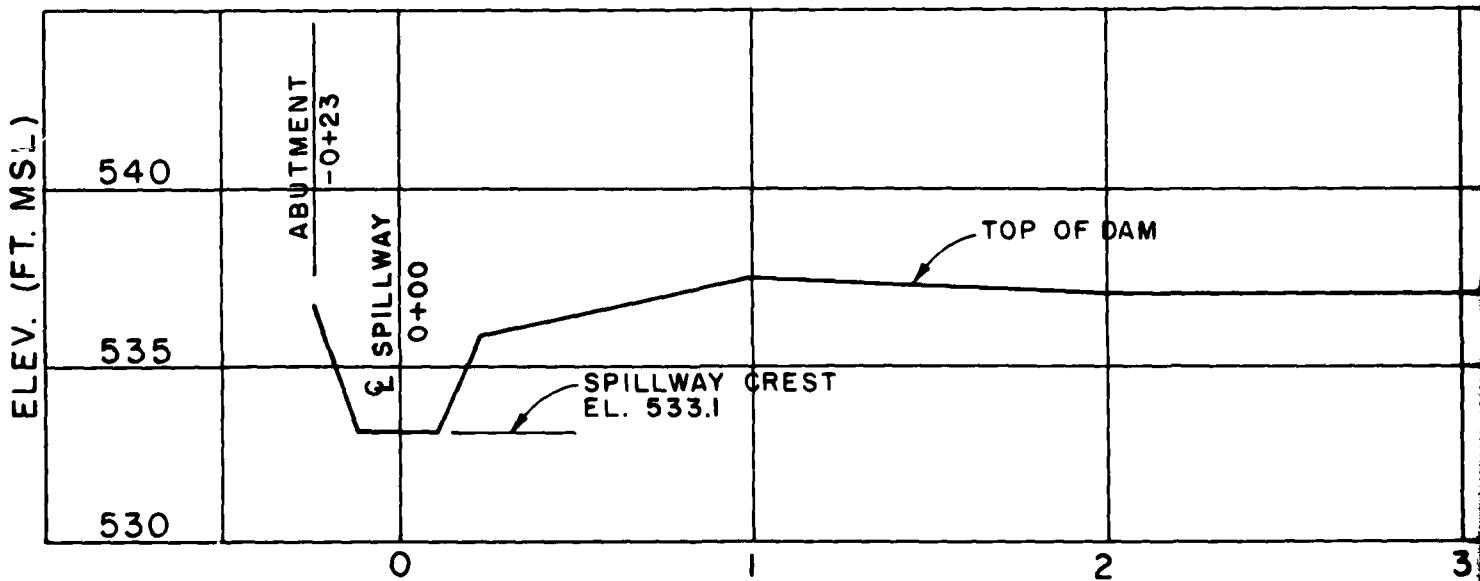
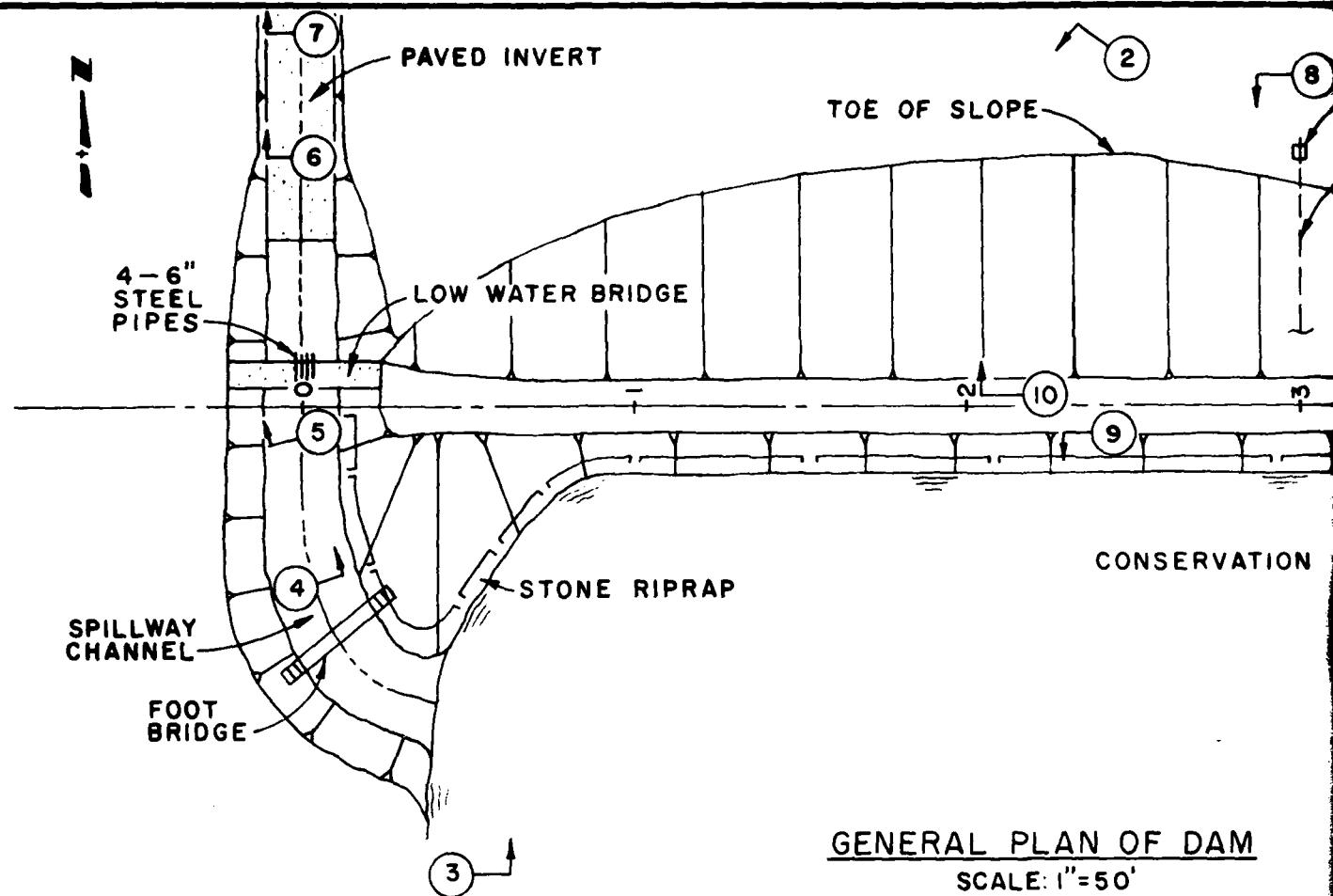


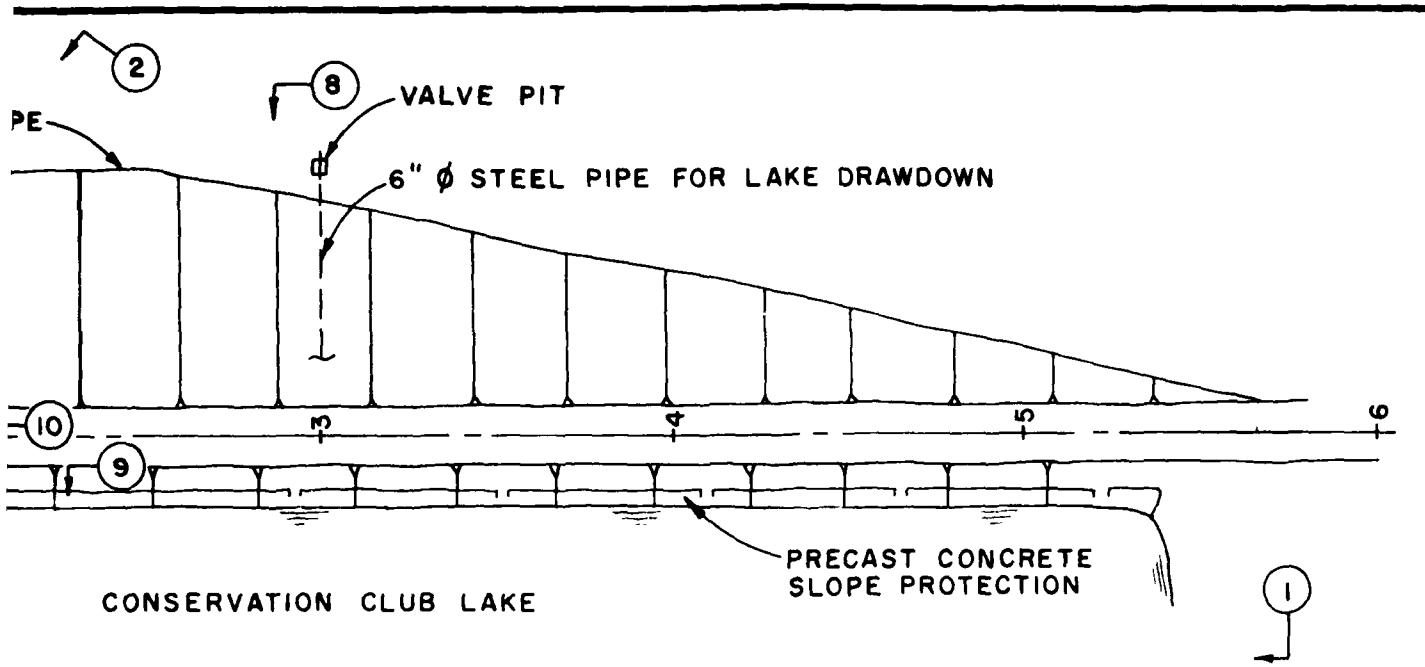
PLATE 2

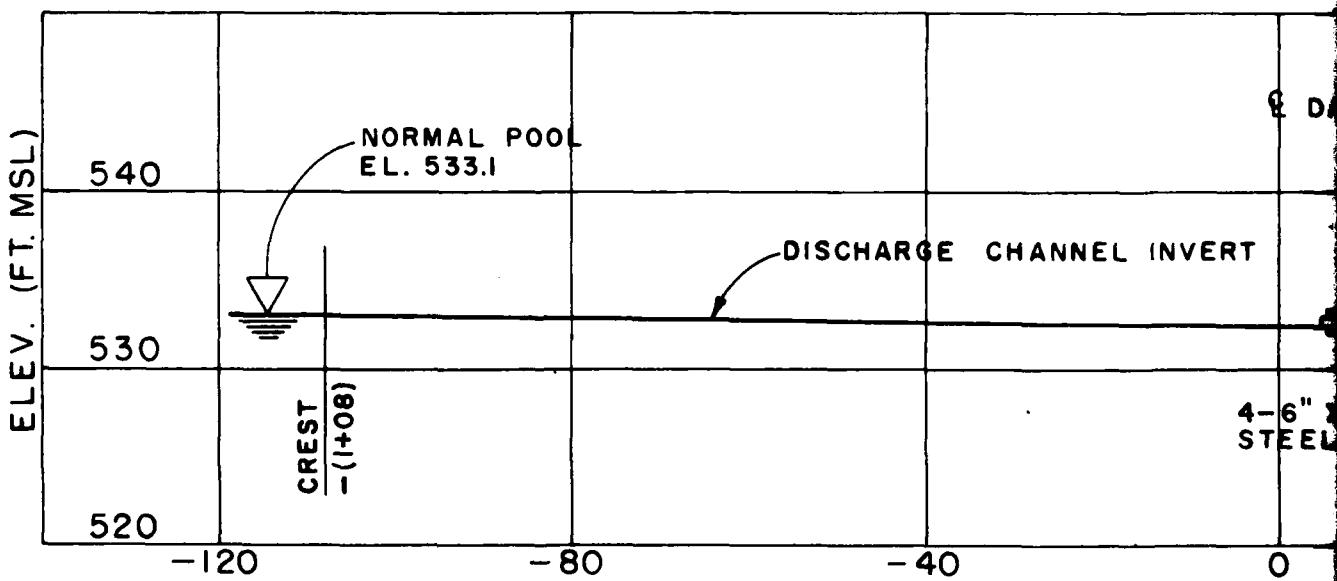
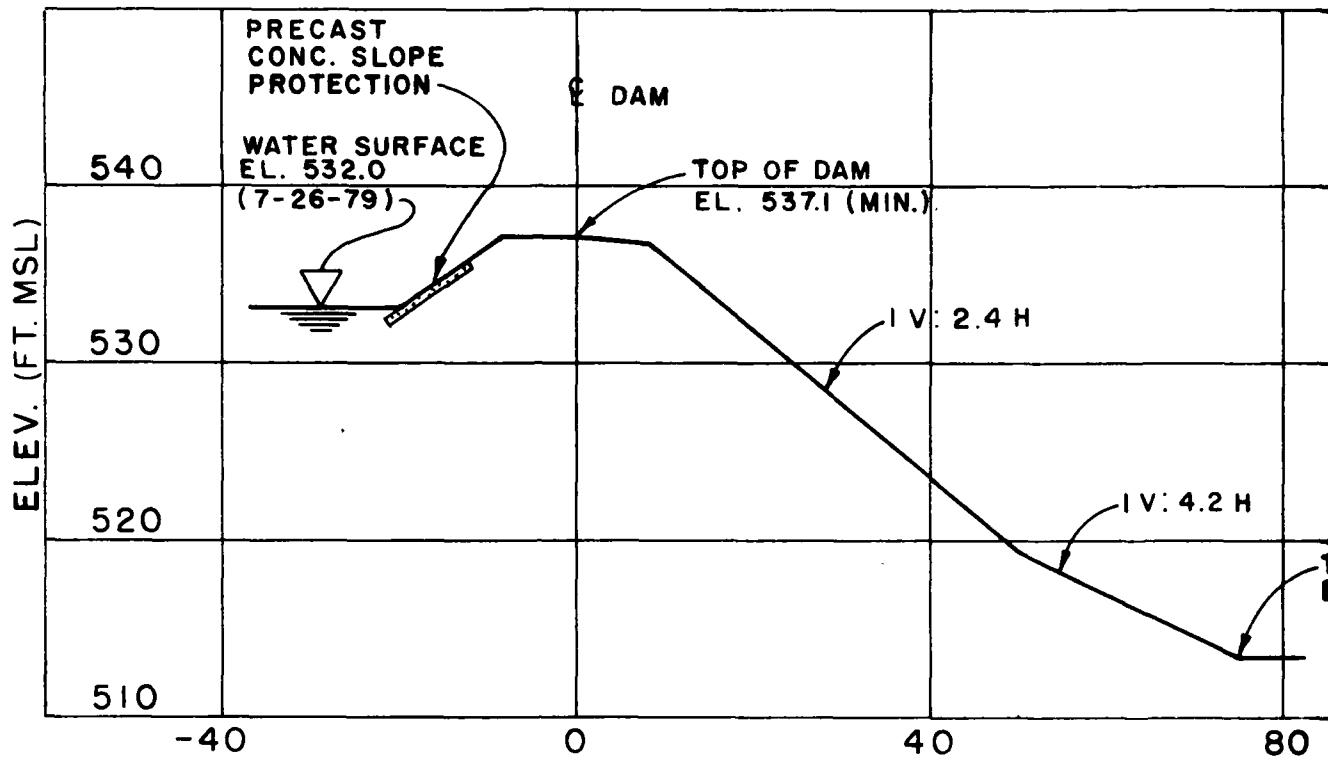


PROFILE DAM CREST

SCALES: 1"=5'V., 1"=50'H.

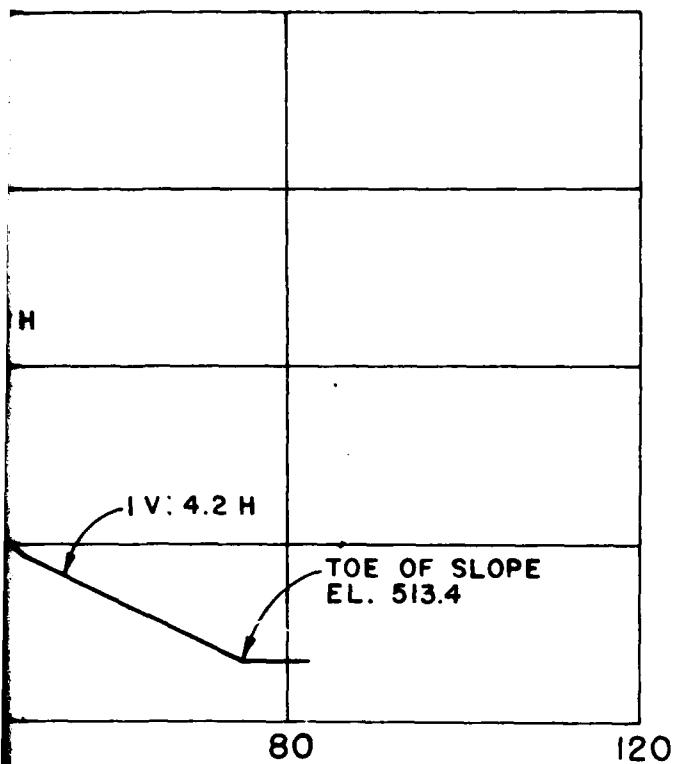
PHOTO LOCATION & KEY
(SEE APPENDIX A)





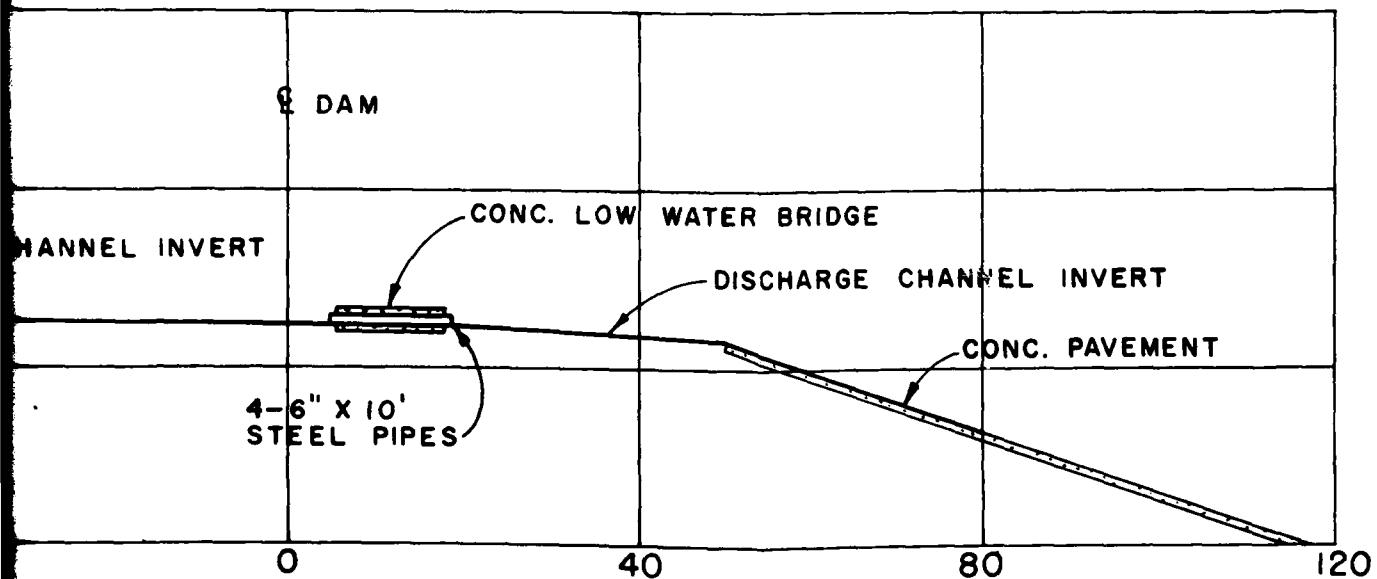
PROFILE SPILLWAY Q

SCALES: 1" = 10' V., 1" = 20' H.

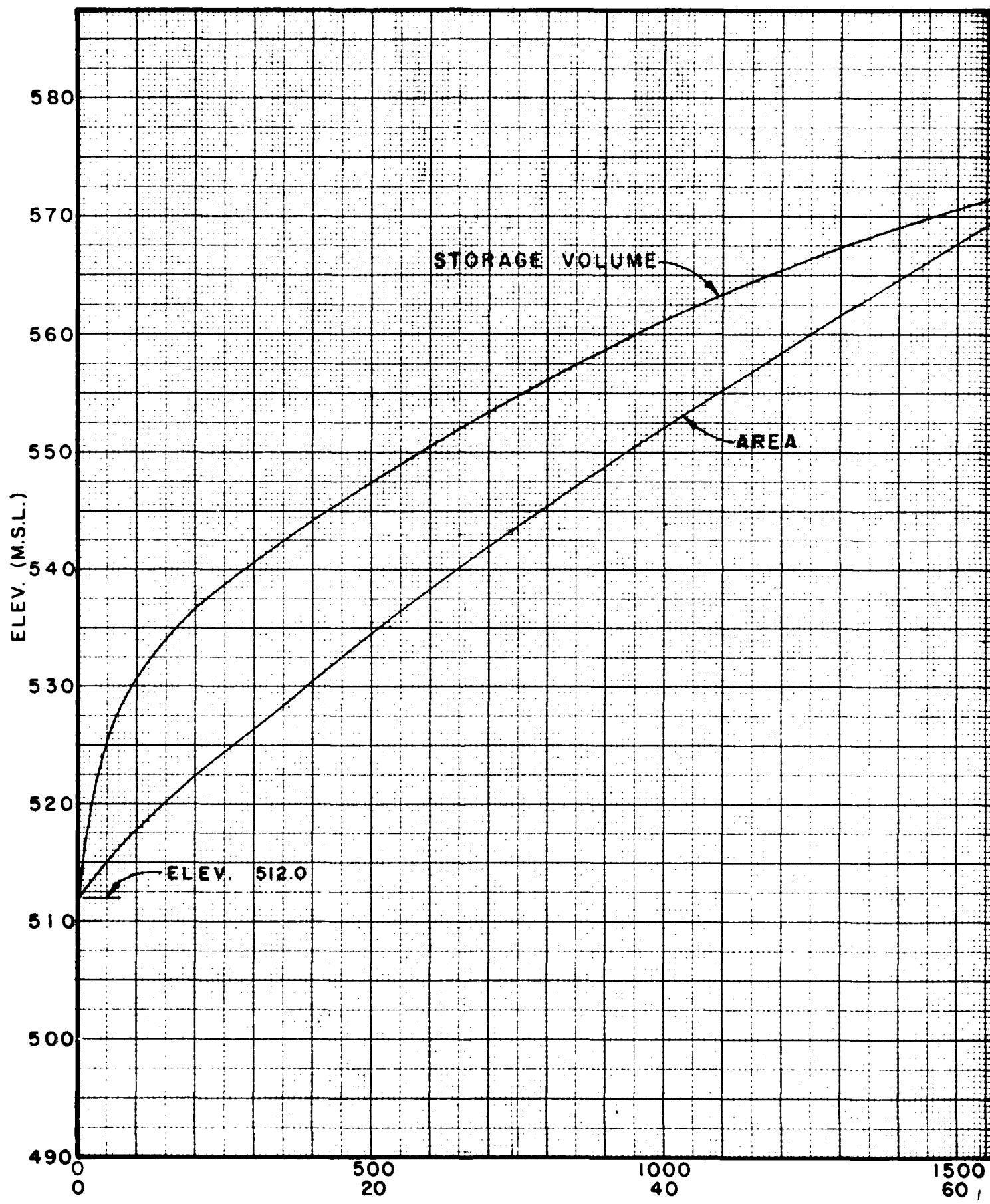


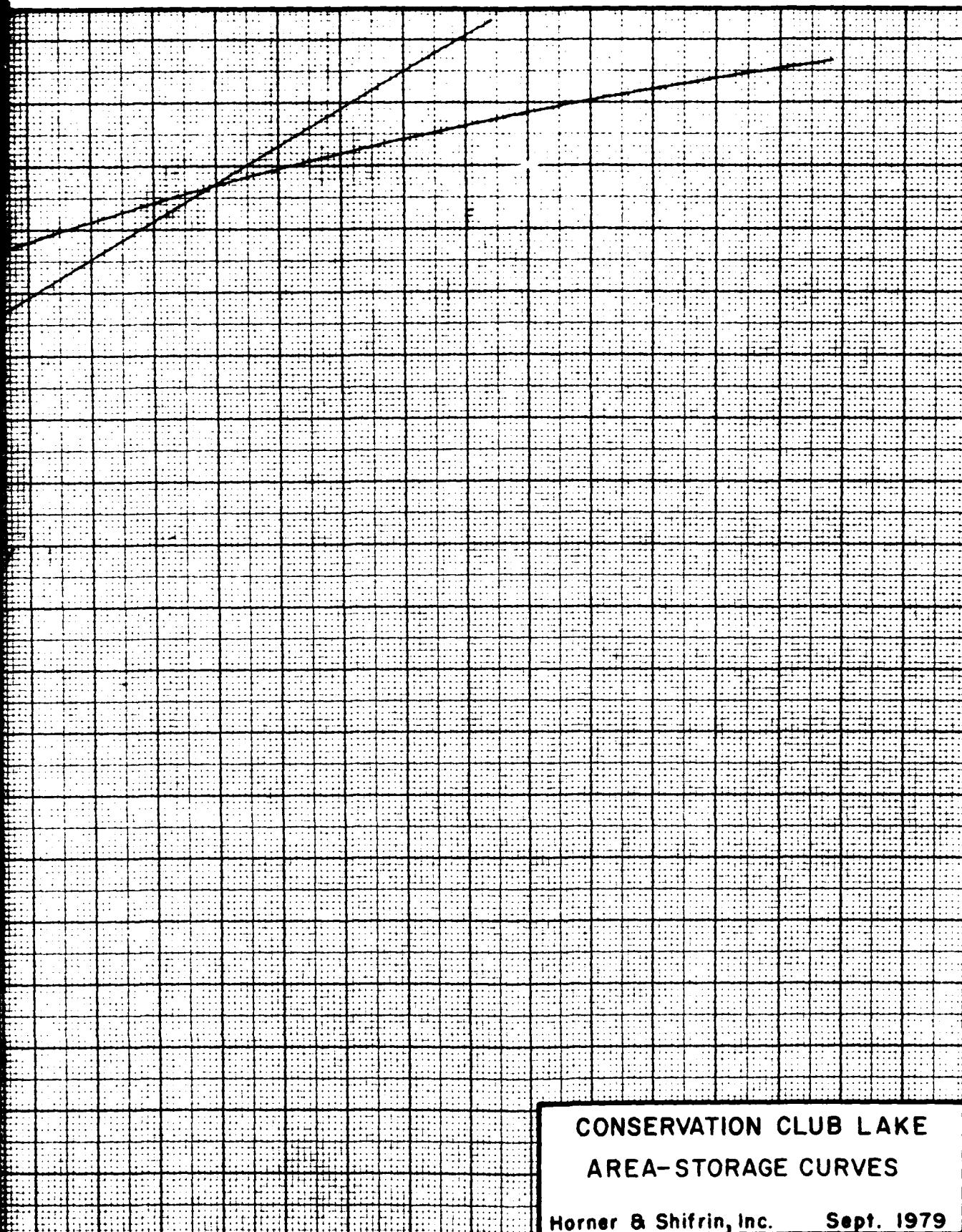
A. 2+50

H.



CONSERVATION CLUB LAKE
DAM CROSS-SECTION &
SPILLWAY PROFILE
Horner & Shifrin, Inc. Sept. 1979





CONSERVATION CLUB LAKE
AREA-STORAGE CURVES

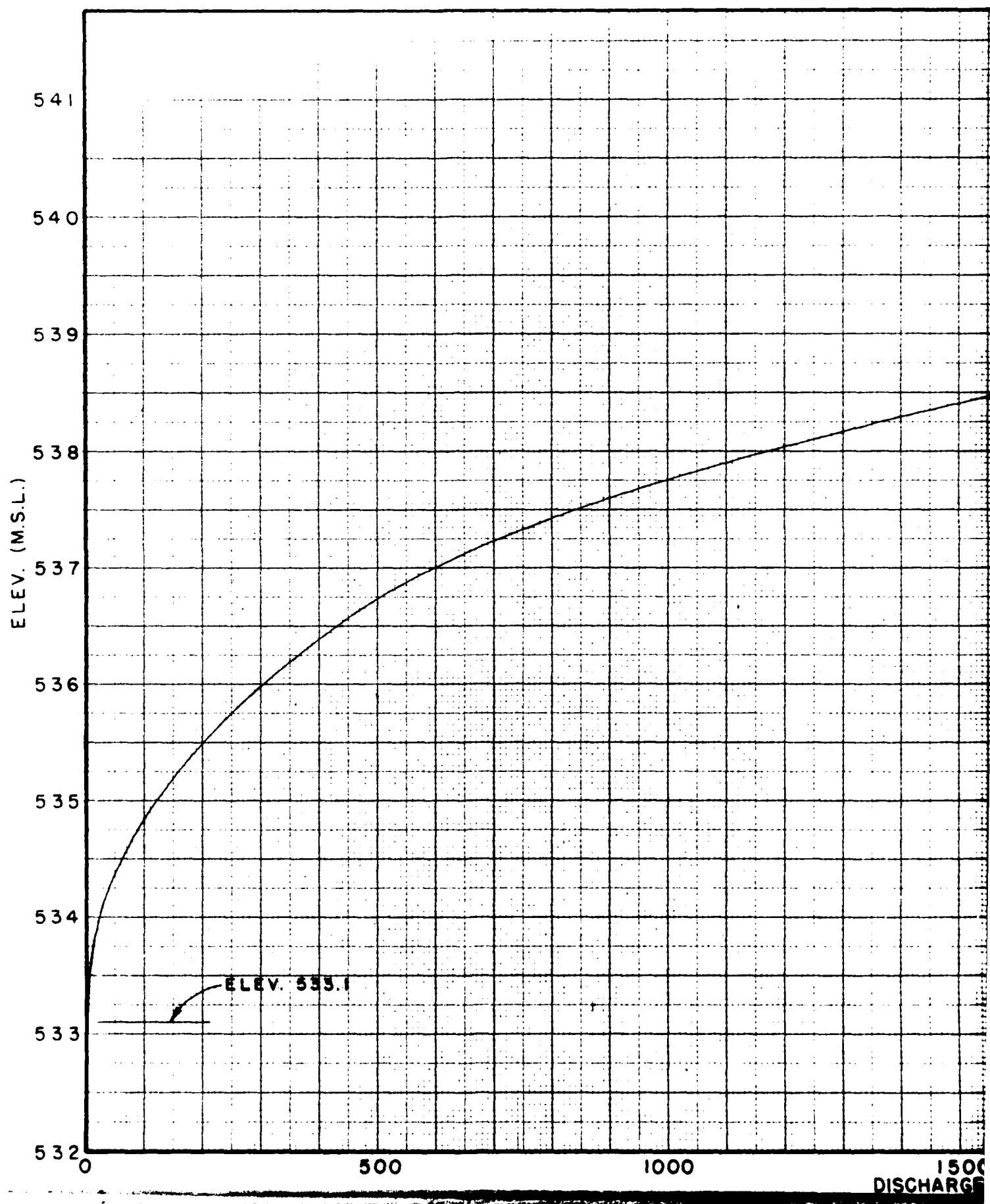
Horner & Shifrin, Inc.

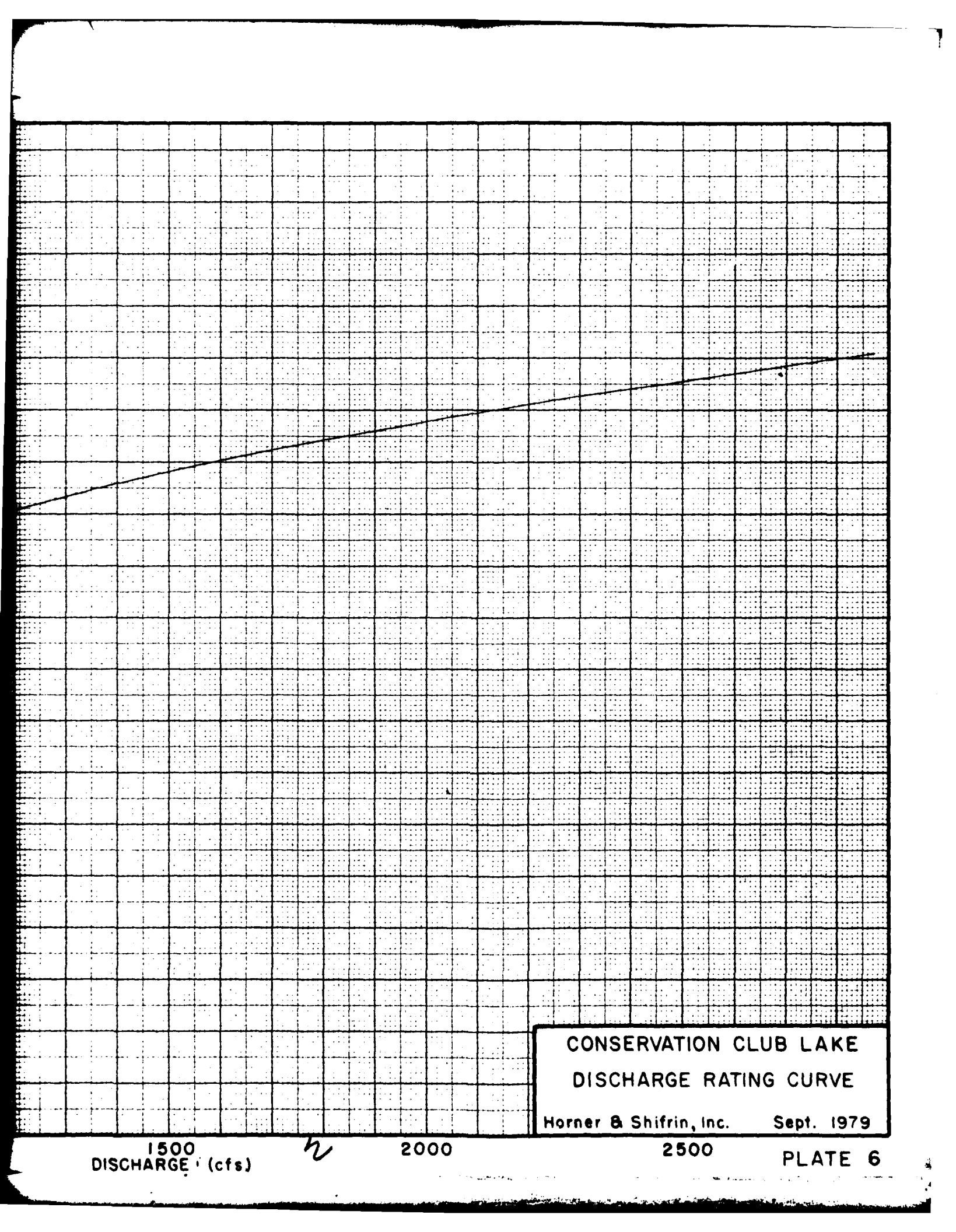
Sept. 1979

1500 VOLUME (ACRE-FT) 2000
60, AREA (ACRES) 80

2500
100

PLATE 5





APPENDIX A
INSPECTION PHOTOGRAPHS

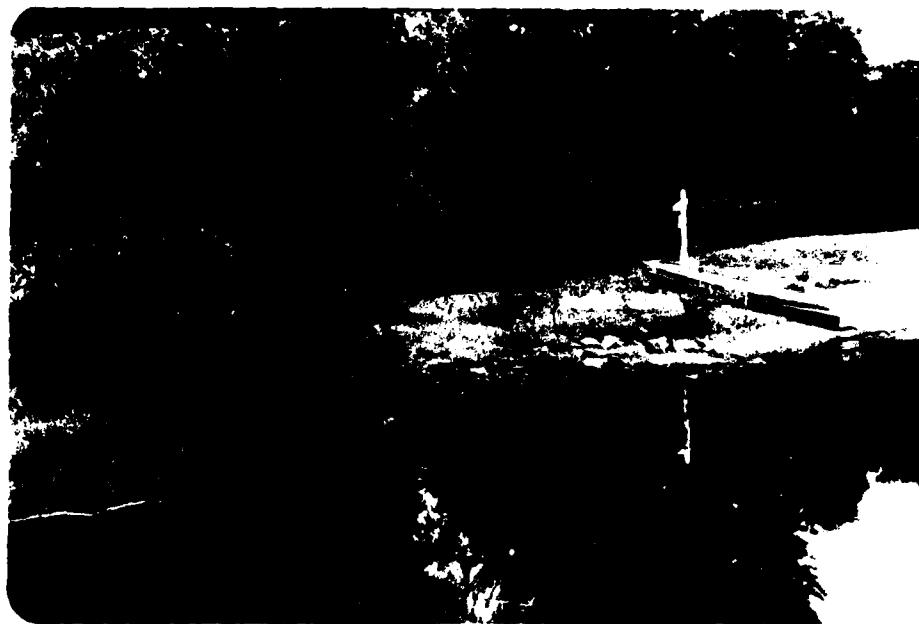
INSPECTION PHOTOGRAPHS - CONSERVATION CLUB LAKE DAM



NO. 1: UPSTREAM FACE OF DAM



NO. 2: DOWNSTREAM FACE OF DAM



NO. 3: SPILLWAY APPROACH CHANNEL AND CREST



NO. 4: SPILLWAY OUTLET CHANNEL



NO. 5: LOW-WATER BRIDGE AT SPILLWAY CHANNEL



NO. 6: PAVED SPILLWAY CHANNEL INVERT



NO. 7: DETERIORATED PAVED SPILLWAY CHANNEL INVERT



NO. 8: VALVE PIT AND 6-INCH DRAWDOWN PIPE OUTLET



NO. 9: CONCRETE SLOPE PROTECTION



NO. 10: DOWNSTREAM CHANNEL NEAR DAM

APPENDIX B
HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1978, Modified 26 February 1979) program was used to develop inflow and outflow hydrographs and dam overtopping analyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. miles, 24-hour value equals 25.5 inches) from Hydrometeorological Report No. 33. The precipitation data used in the analysis of the 1 percent (100-year flood) was provided by the St. Louis District, Corps of Engineers.

b. Drainage area = 0.26 square miles = 166 acres.

c. SCS parameters:

Soil Group B = 100 percent

Soil Type CN = 61 (AMC II, 100-yr. flood condition)
= 78 (AMC III, PMF condition)

Lag time = 0.60 T_c (SCS Method) = 0.068 hours

Time of Concentration (T_c) = $\frac{11.9L^3}{H} 0.385$ = 0.113 hours

Where: T_c = Travel time of water from hydraulically most distant point to point of interest, hours.

L = Length of longest watercourse, miles.

H = Elevation difference, feet.

2. The spillway section consists of a broad-crested, trapezoidal section for which conventional weir formulas do not apply.

Spillway release rates for this section were determined as follows:

a. Spillway crest section properties (area, "a" and top width, "t") were computed for various depths, "d".

b. It was assumed that flow over the spillway crest would occur at critical depth. Flow at critical depth (Q_c) was computed as: $Q_c = \left(\frac{d^3 g}{t}\right)^{0.5}$ for the various depth, "d". Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.

c. Static lake levels corresponding to the various values passing over the spillway were computed as critical depths plus critical velocity heads ($d_c + H_{vc}$). and the relationship between lake level and spillway discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the spillway.

3. The profile of the dam crest is irregular and flow over the dam crest cannot be determined by conventional weir formulas. Flow quantities overtopping the dam crest were computed as described in the preceding paragraph and corresponding flow over the dam and spillways for given elevations were added to obtain the combined outflow rating curve for the dam and spillway.

4. A listing of the HEC-1 (Dam Safety Version) input data for routing the probable maximum flood and the 1 percent chance (100-year frequency) flood is shown on Pages B-3 and B-4 of the Appendix. A copy of the computer output table entitled "Summary of Dam Safety Analysis" is presented on Page B-5 and the inflow and outflow hydrographs for the probable maximum flood are shown on Page B-6 of the Appendix. Area-storage curves for the reservoir are presented on Plate 5 and the spillway discharge rating curve is shown on Plate 6.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF HYDROLOGIC - HYDRAULIC RATIOS OF PMF RELATED THROUGH PESURVIR		ANALYSIS OF SAFETY OF CONSERVIR		CLUE LAKE DAM	
A1					
A2					
A3					
B1	2.83				
B2	5				
J1	1	4	1	1	0
J1	• 43	• 50	• 51	1.0	
K1	0	INFLD			
K1	1	INFLD	HYDROGRAPH		
P	0	2	0.26		
T	0	25.5	102		
Y2	-1.0	0.063			
X2	-1.0	-0.10	2.0		
X1	2	1.04			
Y1	1	1			
Y4	533.1	534.1	535.0	36.2	36.7
Y4	541.5	543.0	544.5	546.0	537.4
Y5	5	31	96	192	125
Y5	4914	6940	9166	11633	766
S4	512.0	512.0	512.4	520.5	76.2
S3	533.1	533.1	533.1	540	540
S0	537.1	441	551	559	125
S1	537.3	537.5	539.0	539.0	541.0
S2	537.7	537.9	538.5	539.0	540.0

ANALYSIS OF A GRANULOCYTIC NATALYLISIS OF THE ERYTHROCYTE MEMBRANE - CLOTHESLINE LAKE DAM

ANALYSIS OF DAM OVERFLOW ISSUES USING 100-YR FLOOD HYDRAULIC ROUTE		100-YR FLOOD		100-YR FLOOD HYDRAULIC ROUTE							
442	443	444	445	446	447	448	449	450	451	452	453
454	455	456	457	458	459	460	461	462	463	464	465
466	467	468	469	470	471	472	473	474	475	476	477
478	479	480	481	482	483	484	485	486	487	488	489
490	491	492	493	494	495	496	497	498	499	500	501
502	503	504	505	506	507	508	509	510	511	512	513
514	515	516	517	518	519	520	521	522	523	524	525
526	527	528	529	530	531	532	533	534	535	536	537
538	539	540	541	542	543	544	545	546	547	548	549
550	551	552	553	554	555	556	557	558	559	560	561
562	563	564	565	566	567	568	569	570	571	572	573
574	575	576	577	578	579	580	581	582	583	584	585
586	587	588	589	590	591	592	593	594	595	596	597
598	599	600	601	602	603	604	605	606	607	608	609
610	611	612	613	614	615	616	617	618	619	620	621
622	623	624	625	626	627	628	629	630	631	632	633
634	635	636	637	638	639	640	641	642	643	644	645
646	647	648	649	650	651	652	653	654	655	656	657
658	659	660	661	662	663	664	665	666	667	668	669
670	671	672	673	674	675	676	677	678	679	680	681
682	683	684	685	686	687	688	689	690	691	692	693
694	695	696	697	698	699	700	701	702	703	704	705
706	707	708	709	710	711	712	713	714	715	716	717
718	719	720	721	722	723	724	725	726	727	728	729
730	731	732	733	734	735	736	737	738	739	740	741
742	743	744	745	746	747	748	749	750	751	752	753
754	755	756	757	758	759	760	761	762	763	764	765
766	767	768	769	770	771	772	773	774	775	776	777
778	779	780	781	782	783	784	785	786	787	788	789
790	791	792	793	794	795	796	797	798	799	800	801
802	803	804	805	806	807	808	809	810	811	812	813
814	815	816	817	818	819	820	821	822	823	824	825
826	827	828	829	830	831	832	833	834	835	836	837
838	839	840	841	842	843	844	845	846	847	848	849
850	851	852	853	854	855	856	857	858	859	860	861
862	863	864	865	866	867	868	869	870	871	872	873
874	875	876	877	878	879	880	881	882	883	884	885
886	887	888	889	890	891	892	893	894	895	896	897
898	899	900	901	902	903	904	905	906	907	908	909
910	911	912	913	914	915	916	917	918	919	920	921
922	923	924	925	926	927	928	929	930	931	932	933
934	935	936	937	938	939	940	941	942	943	944	945
946	947	948	949	950	951	952	953	954	955	956	957
958	959	960	961	962	963	964	965	966	967	968	969
970	971	972	973	974	975	976	977	978	979	980	981
982	983	984	985	986	987	988	989	990	991	992	993
994	995	996	997	998	999	999	999	999	999	999	999

SUMMARY OF DAM SAFETY ANALYSIS

RATIOS OF PMF

INITIAL ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
533.09	533.10	537.10	537.10
135.	135.	220.	220.
0.	0.	647.	647.

ELEVATION	STORAGE	OUTFLOW
537.09	537.09	0.
537.14	537.14	0.
537.19	537.19	0.
537.30	537.30	0.

RATIO OF PMF	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF FAILURE HOURS
0.49	537.09	0.00	219.	642.	0.00
0.50	537.14	0.04	221.	661.	0.17
0.51	537.19	0.05	222.	681.	0.33
1.00	537.30	1.20	249.	3025.	1.75

SUMMARY OF DAM SAFETY ANALYSIS

INITIAL ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
533.09	533.10	537.10	537.10
135.	135.	220.	220.
0.	0.	647.	647.

RATIO OF PMF	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF FAILURE HOURS
1.00	534.31	0.00	159.	50.	0.00

INFLOW
4097 cfs

CONSERVATION CLUB LAKE
PMF INFLOW & OUTFLOW
HYDROGRAPHS

Horner & Shifrin, Inc.

Dec. 1979

